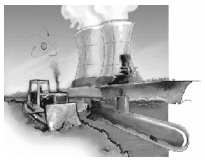
Platelet-Cooled Plasma Arc Torch

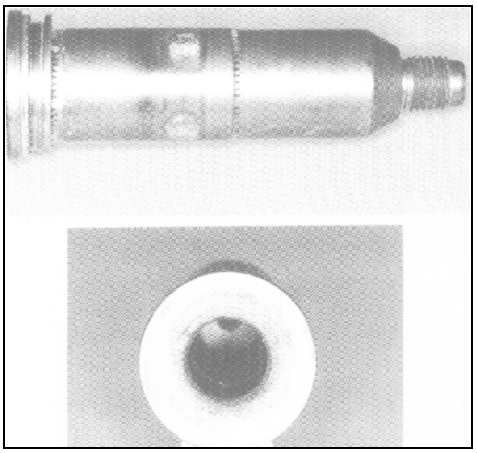


Developer: Aerojet General Corporation
Contract Number: DE-AR21-93MC30361
Crosscutting Area: N/A

Mixed Waste FOCUS AREA

Problem:

A longer lasting plasma arc torch is needed to reduce worker exposure to radioactive environments while performing equipment maintenance. A longer electrode life would also allow for fewer electrodes to be discarded as low level wastes.



Solution:

Platelet-cooled plasma arc torch anodes are projected to extend the life of the plasma arc torch.

Benefits:

- Extended plasma arc vitrification process runs
- Reduced potential for health risks
- Improved process efficiency due to reduced frequency of torch replacement
- Reduction in low level waste volume

Technology:

The platelet cooling concept was invented in the 1960's to provide long operating life in the severe chemical and thermal environment of a rocket engine. Platelet transpiration-cooled injectors increased operating life from 918 cycles to over 4200 cycles on an O_2H_2 high heat flux combustion device tested at NASA Lewis (Mueggenburg and Repas, 1990). Thirteen specific types of platelet thermal management devices have been fabricated and tested. The original platelet cooling application was for transpiration cooled combustion chambers and missile nosetips which operated at over 100 Btu/in^2 sec heat flux and are similar in concept to two of the designs proposed for the plasma arc torch. During subsequent work, purely convectively cooled devices were fabricated from platelets and test proven. An example is the 40,000 lbf thrust O_2H_2 combustion chamber tested recently at the Marshall Space Flight Center (Janke and Hayes, 1992).

Extending anode life will reduce operating costs. Unscheduled down times that are the result of anode wear or failure entail process costs in addition to those associated with the replacement and disposal costs of the anode. The need to break into arc heating systems for electrode servicing in systems used for vitrification of low level radioactive material can make the application impractical. The use of proven platelet technology to mitigate these maintenance problems will make the waste management process more efficient and cost effective.

Project Conclusion:

This project was completed in November 1994. In this successful program, Aerojet designed three different anode concepts for platlet-cooled plasma arc torches, fabricated two copies of each design, and delivered the six pieces of hardware to RETECH, Inc. of Ukiah, Ca, for evaluation and

testing in their plasma arc facility. The tests were performed using a Retech 75T (90 MW) plasma arc torch capable of processing mixed radioactive waste. Two of the electrodes with gas injection through the electrode wall demonstrated between eight and forty times the life of conventional water cooled electrodes. A projection was made that a 1 MW size electrode would possess thousands of hours of life during vitrification processes of DOE mixed waste.

Contacts:

Aerojet Corporation, through its Research and Development Division, is engaged in product improvement and innovative product development. For information on this project, the contractor contact is:

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DOE's Morgantown Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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